"AUTOMATIC MULTI-FUNCTION MULTI-NEEDLE SEWING MACHINE, AND RELATIVE SEWING METHOD"

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FIELD OF THE INVENTION

The present invention concerns an automatic multi-function multi-needle sewing machine, able to perform multiple stitches with an unlimited number of patterns, embroideries and ornamental designs, or able to apply decorative strips, paillettes, ribbons and trimmings, or able to apply crimped tapes onto simple, multi-layer or padded fabrics, fed continuously from rolls, or to crimp simple fabrics or fabrics with a lining below, fed continuously from rolls, or again to apply tapes or ribbons transverse to the direction of feed of the fabric.

The sewing machine according to the present invention is advantageously but not exclusively an automatic multi-function multi-needle sewing-quilting-embroidering machine.

The invention also concerns a sewing method that allows to make different workings for each of which, until now, it would have been necessary to have different specific sewing machines available.

The invention is preferentially, though not exclusively, applied on multi-needle quilting machines, both of the type which make knotted point and chain point stitches.

BACKGROUND OF THE INVENTION

In the field of sewing machines and embroidery, it is known to automatically apply ribbons, strips and paillettes on fabrics cut into pieces, or to apply manually crimped tapes on fabrics cut into pieces, or to crimp fabrics in pieces or from rolls.

For each of the above applications, however, it is necessary to use specific machines, each of which can perform a single type of work, which therefore require, in

the case of workings performed in sequence, manual steps to reposition the fabrics cut into pieces with every productive cycle, which entails a considerable expense and energy consumption.

One purpose of the present invention is to achieve a single automatic multi-function multi-needle sewing machine, which allows to perform indifferently, by means of rapid and simple reconfiguring operations, one or the other of a plurality of different and differentiated functions in the type of stitching, of accessory applied, for example ribbons, trimmings, paillettes, tapes, longitudinally or transversely to the fabric, crimping operations, or other, according to the clients' requests.

Another purpose of the present invention is to achieve a sewing machine that will allow continuous working of simple, multi-layer and padded fabrics, obtaining any ornamental pattern whatsoever of the stitches by means of an electronic control.

The Applicant has devised, tested and embodied the present invention to overcome these shortcomings of the state of the art, and to obtain further advantages as will be explained hereafter.

SUMMARY OF THE INVENTION

The present invention is set forth and characterized in the respective main claims, while the dependent claims describe other characteristics of the main embodiment.

In accordance with the above purposes the sewing machine according to the present invention comprises at least a needle-bearing bar on which a plurality of needles are mounted, each one fed with its own thread called needle thread. The needle-bearing bar is able to be moved alternately with an ascending-descending movement, to take every needle to cooperate with a mating lower sewing

element, for example consisting of a shuttle, a rotary crochet or a mobile hook, also equipped with alternating movement mating with the movement of the needle-bearing bar.

The cooperation between the needles and the lower sewing elements determines the sewing of stitches, both knotted point and double chain point stitches, on simple, multi-layer or padded fabrics, fed continuously from rolls and interposed between said sewing members.

According to a characteristic feature of the present invention, the sewing machine also comprises at least an auxiliary supporting bar cooperating with the needle-bearing bar, and able to be moved alternately in an ascending-descending direction, with a movement coordinated to that of the needle-bearing bar. According to the invention, a series of different accessory elements are able to be selectively associated with the auxiliary supporting bar, by means of standardized attachment means, so as to perform selectively one or the other of at least the following operations:

i) to make multiple stitches with an unlimited number of ornamental patterns or designs on simple, multi-layer or padded fabrics fed continuously from rolls;

ii) automatic application, by means of stitches suitable to achieve a desired ornamental pattern or design, of a strip, a ribbon or a trimming on simple, multi-layer or padded fabrics fed continuously from rolls;

iii) automatic application, by means of stitches suitable to achieve a desired ornamental pattern or design, of paillettes on simple, multi-layer or padded fabrics fed continuously from rolls;

iv) automatic application, by means of rectilinear stitches or with a plurality of ornamental designs, of tapes crimped

using different crimping systems on simple, multi-layer or padded fabrics fed continuously from rolls;

v) automatic crimping over the entire width, by means of stitches, of simple fabrics, or fabrics with a lining beneath, fed continuously from rolls;

vi) automatic application, by means of parallel stitches, of tapes, ribbons or trimmings disposed transverse to the direction of feed of the fabrics on simple, multi-layer or padded fabrics fed continuously from rolls with the possibility of varying as desired the distance between the tapes; and

vii) preparation for the application of new accessories for the execution of ornamental embellishments with other characteristics requested by the user at a later time.

According to another characteristic feature of the present invention, parts of said accessory elements comprise movement means, also of a standardized type, able to allow on each occasion the specific achievement of said operations.

In a first form of preferential embodiment of the present invention, the standardized attachment means comprise a plurality of housings for said accessory elements, disposed contiguous so as to cover the upper surface of the auxiliary supporting bar, each of which has a length that substantially corresponds to the distance between two contiguous needles; each accessory element has at least a part, of a size correlating to that of each of said housings, so as to be able to be selectively positioned and clamped inside them so that at least a needle can cooperate therewith during the working step.

In a second form of preferential embodiment of the present invention, the standardized attachment means comprise a linear guide attached on the auxiliary

supporting bar and able to allow the positioning, by means of transverse sliding, and the subsequent attachment in the operating position of the accessory element with respect to the latter.

According to a variant, on the lower surface of the auxiliary supporting bar there are sliding means for a toothed belt, advantageously having a development adequate to cover the entire lateral perimeter of the auxiliary supporting bar.

In another preferential embodiment, at the ends of the auxiliary supporting bar there are command, guide and return means for said toothed belt. The command means comprise at least a pulley connected to a command motor.

According to a variant, the command motor is managed by a programmable control unit in order to impart to the toothed belt movements with a cadence, amplitude and direction of movement that vary according to the type of operation to be performed.

According to the invention, the accessory elements are selectively chosen from standard static feet or feet of a robotized type according to the work to be done.

Inside these two types, the feet can be of different types according to the application or specific operation to be made on the fabric.

For example, when multiple stitches have to be done with an unlimited number of ornamental patterns or designs on simple, multi-layer of padded fabrics, fed continuously from rolls, a plurality of standard feet are mounted on the auxiliary supporting bar by means of said standardized attachment means; apart from the standardized part to connect with the auxiliary supporting bar, the standard feet have a shaped part equipped with suitable holes through which the corresponding needles pass, mounted on

the respective needle-bearing bar.

In this type of working, the auxiliary supporting bar behaves like a simple fabric-pressing plate and the toothed belt and its command motor remain inactive.

On the contrary, when applications of strips, ribbons or trimmings are to be made by means of stitches on simple, multi-layer or padded fabrics fed continuously from rolls, a plurality of robotized feet, for example of the ECORDING type, are mounted on the auxiliary supporting bar, again by means of said standardized attachment means; apart from the standardized part to connect with the auxiliary supporting bar, the robotized feet have a shaped part protruding laterally from the auxiliary supporting bar itself, in which an idle toothed pulley rotating on bearings is mounted.

Each toothed pulley comprises a cylindrical insert, provided with an axial hole for the needle, and with other holes and/or hollows with different diameters and widths, disposed eccentric with respect to the axial hole, and through which the strips or tapes to be applied pass.

Again with the same robotized feet it is possible to apply strips on simple, multi-layer or padded fabrics fed continuously from rolls. In this case, according to the type of strip to be applied, the hole through which the chosen strip passes is automatically positioned in the correct working position with respect to the needles.

Again with the same robotized ECORDING feet it is possible to apply tapes on simple, multi-layer or padded fabrics fed continuously from rolls. In this case, the tapes are threaded into the eccentric hollows of the inserts of corresponding width and, according to the type of tape, the corresponding eccentric hollow is positioned in the correct working position with respect to the

needles.

On the contrary, when crimped tapes are to be applied on simple, multi-layer or padded fabrics fed continuously from rolls, the RIRI type robotized feet are mounted on the auxiliary supporting bar by means of said standardized attachment means, in the positions corresponding to the needles intended to be used.

The RIRI type robotized feet are equipped with toothed pulleys having a central hole through which the sewing needle passes, and allow to make a tape advance intermittently which is sewn by the needle, with adjustable crimping.

Each of the pulleys is also equipped with a cam that drives a sliding pad made of anti-friction material, on which is attached, with a slight inclination, a movable blade, which slides on a fixed blade underneath, attached rigidly to the robotized foot of the auxiliary supporting bar.

In this case, the command motor imparts to the toothed belt alternate movements that are repeated by the pulley of the RIRI type robotized foot, and transformed by the command cam into alternate backwards-and-forwards movements of the movable blade with respect to the fixed blade. Due to the effect of the alternating movements, the movable blade thrusts the tape forwards, making it slide on the fixed blade, so as to crimp the tape before it is sewn by the needle.

In this solution, by varying as desired the movements of the command motor, it is possible to make the movable blade perform more or less ample travels and consequently obtain different types of crimping of the tape.

On the contrary, if the crimping is to be performed over the whole width of simple fabrics or with a lining beneath,

fed continuously from rolls, PLISSE' type robotized feet are mounted on the auxiliary supporting bar by means of said standardized attachment means, in the positions corresponding to the needles intended to be used.

The PLISSE' type robotized feet are similar to the RIRI type robotized feet and have only the upper blade which acts directly on the fabric to be crimped, making it slide forwards, either on the sliding surfaces of the materials of the sewing machine, or above the underlying lining if it is present.

The amplitude of the feed of the fabric to be crimped can be modified by suitably programming the command motor of the belt, and consequently the crimping can be more or less tight, according to the amplitude of the travel of the movable blade.

On the contrary, if paillettes or strass, or other similar ornamental elements, are to be applied by means of stitches on simple, multi-layer or padded fabrics, fed continuously from rolls, a plurality of robotized feet, for example of the PAILLETTES type, are mounted on the auxiliary supporting bar, in the positions corresponding to the needles intended to be used and by means of said standardized attachment means. Apart from the standardized part to connect with the auxiliary supporting bar, the feet have a part protruding laterally from the auxiliary supporting bar itself.

The PAILLETTES type robotized feet are each equipped with an assembly to feed and cut the paillettes and are commanded by a toothed element, for example a pulley, rotating idle, having a hole through which the sewing needle passes. Each of said rotating toothed elements drives, in a preferential embodiment, a sliding pad made of antifriction material, on which a cursor is fixed that

supports a foil.

In this case, the command motor imparts to the toothed belt rotational movements that are repeated by the rotating toothed element of the PAILLETTES type robotized foot and transformed into alternating backwards-and-forwards movements of the sliding pad, and hence of the cursor and of the foil. These movements cause the first paillette of the strip that has to be applied to find itself with its hole in axis with the hole of the rotating toothed element through which the needle passes. During the backward travel of the sliding pad, the following paillette of the strip of paillettes is engaged by the foil. During the forward travel of the sliding pad, the strip of paillettes is thrust forwards, exactly centering the first paillette with the axis of the sewing needle.

According to the operating cycle, the advance movement of the strip of paillettes occurs during the descending movement of the sewing needle, so that the needle enters the hole of the paillette to be applied (the first on the strip) at the moment when the paillette itself is centered with the axis of the needle. At this point, it becomes necessary to cut the paillette from the strip in order to allow it to be attached by the sewing needle.

For this purpose a rotary blade is provided, inserted in the lower part of the hole of the rotating toothed element through which the needle passes.

In a preferential embodiment, the bobbin that feeds the strip of paillettes is positioned above the PAILLETTE foot and is supported by an arm equipped with a pin on which the bobbin rotates, attached to the structure of the machine.

In order to apply the paillettes three different systems are possible: sequential, superimposed and with star point.

In the case of sequential application, the sewing needle

descends, enters the hole of the first paillette which is simultaneously cut from the strip, and sews the first side; then, while the needle ascends, the textile material on which the paillette is applied is displaced by an entity equal to the distance between the center of the paillette and its second side, diametrically opposite the first. Then, the needle descends again, attaching the paillette with a second stitch that encompasses the second side, then the needle ascends while the textile material is displaced by the same entity and the new paillette is thrust into position under the needle which, during the descent, enters into the hole of the new paillette, thus restarting the cycle.

In the case of a superimposed application, the sewing needle descends, enters the hole of the first paillette, which is simultaneously cut from the strip, and sews the first side. Then, while the needle ascends, the textile material is displaced by an entity equal to the distance between the center of the paillette and its second side, diametrically opposite the first, and the new paillette is thrust into position under the needle which, during the descent, enters into the hole of the new paillette, which in the meantime is cut from the strip, and sews the first side together with the second side of the previous paillette. Finally, while the needle ascends, the textile material is displaced by the same entity and a new paillette is thrust into position under the needle which, descending, enters into the hole of the new paillette, thus restarting the cycle.

In the case of a star point application, the sewing needle descends, enters the hole of the first paillette which is simultaneously cut from the strip, and fixes the first side. Then, while the needle ascends, the textile

material is displaced by an entity equal to the distance between the center of the paillette and a peripheral point of the same paillette located at 120° from the first stitch made by the needle; then the needle descends again and fixes this second side. While the needle ascends, the textile material is displaced so that the center of the paillette is in axis with the needle that descends again; then, while the needle ascends, the textile material is again displaced by an entity equal to the distance between the center of the paillette and a peripheral point of the same paillette located at 120° from the second, then the needle descends again and fixes this third side. While the needle ascends, the textile material is displaced so that the center of the paillette is in axis with the needle that descends again; then while the needle ascends, the textile material is displaced by an entity equal to the distance between the centers of two contiguous paillettes and finally the needle descends again, enters the hole of the new paillette which simultaneously is cut from the strip and the cycle begins again.

Apart from the continuous application of paillettes, both sequential and superimposed, and with star point, it is also possible to alternate the application of paillettes with segments of normal stitching or embroidery type, and thus create an extremely high number of ornamental designs of considerable variety and beauty.

The PAILLETTES type robotized foot is suitable to apply paillettes of a varying diameter, for example 3 mm, 5 mm, 7 mm, after suitable modifications.

In the embodiment that provides the possibility to apply tapes, ribbons or trimmings disposed transverse to the direction of feed of the fabrics, all the feet, standard or robotized, which are possibly present on the front part of

the auxiliary supporting bar are dis-assembled, and a TRESSE' type slider must be applied, in this case by means of the sliding linear guide.

The TRESSE' type slider is equipped with a toothed pulley substantially equal to that of the ECORDING type robotized feet.

On the TRESSE' type slider a device to cut the needle thread is also provided and a clamping device to selectively clamp the rotation of the toothed pulley so that, if the toothed pulley is made to move when the pulley is clamped, the TRESSE' type slider is drawn by the toothed belt and slides transversely on the appropriate guide along the front part of the auxiliary supporting bar.

In all the above cases, by suitably programming the movement of the fabric, any type of ornamental design can be performed, from the simplest with a linear development, to the most complex and substantially similar to embroidery.

If tapes, ribbons and trimmings are to be applied, disposed transverse to the direction of feed of the fabrics, to each of the two ends of the front needle-bearing bar a needle is mounted without the corresponding standard feet on the auxiliary supporting bar, while on the rear needle-bearing bar a plurality of needles are mounted, corresponding to the number of stitches that are to be made, with the standard feet corresponding to the needles mounted, on the rear part of the auxiliary supporting bar.

In this last case, the tape or ribbon or trimming to be applied is made to pass in the corresponding hollow of the insert of the toothed pulley of the TRESSE' type slider.

The sewing machine according to the invention can thus be used both as a normal sewing machine, for example a multi-needle quilting machine, and as an embroidery machine to

apply strips, ribbons, trimmings, crimped tapes, paillettes, on simple, multi-layer or padded fabrics fed continuously from rolls, and as a machine to apply ribbons, tapes or trimmings disposed transverse to the direction of feed of the fabric, on simple, multi-layer or padded fabrics fed continuously from rolls, and also as a machine to crimp, also over their whole length, simple fabrics or fabrics with a lining beneath, fed continuously from rolls.

With the present invention we thus obtain a single sewing machine that allows to work textile material continuously at an extremely high speed, up to 600-700 stitches a minute and more, obtaining the desired ornamental designs from the simplest to the most complex.

Moreover, the sewing machine according to the present invention is extremely versatile and is potentially suitable to apply other accessory elements in order to perform ornamental embellishments with characteristics different from those cited here.

The sewing machine according to the invention therefore has high productivity, and entails a considerable economic saving both because of the high working speed, and because of the possibility of working continuously on material unwinding from rolls, and also of performing a substantially unlimited number of ornamental designs and patterns, and also because of the extreme flexibility that allows it, simply and rapidly, to perform multiple applications of ornamental designs, for each of which a specific machine would normally be necessary.

BRIEF DESCRIPTION OF THE DRAWINGS

These and other characteristics of the present invention will be apparent from the following description of some preferential forms of embodiment, given as a non-restrictive example, with reference to the attached

drawings wherein:

Fig. 1 is a schematic view of an automatic multi-function multi-needle sewing machine according to the present invention;

Fig. 2 is a three dimensional view of a first enlarged detail of the sewing machine in fig. 1;

Fig. 3 is a view from below of the detail in fig. 2;

Fig. 4 is a three-dimensional view of a second enlarged detail of the sewing machine in fig. 1;

Fig. 5 is a view from below of the detail in fig. 4;

Fig. 6 shows an ECORDING type robotized foot applicable to the sewing machine in fig. 1;

Fig. 7 shows a RIRI type robotized foot applicable to the sewing machine in fig. 1;

Fig. 8 shows a PLISSE' type robotized foot applicable to the sewing machine in fig. 1;

Fig. 9 shows a PAILLETTES type robotized foot applicable to the sewing machine in fig. 1;

Fig. 10 shows a longitudinal section of the PAILLETTES type robotized foot in fig. 9;

Fig. 11 shows the TRESSE' type slider with relative sliding guide applicable to the sewing machine in fig. 1;

Fig. 12 is a plane view of an enlarged detail of the TRESSE' type slider in fig. 11 in a first operating condition;

Fig. 13 is a plane view of an enlarged detail of the TRESSE' type slider in fig. 11 in a second operating condition.

DETAILED DESCRIPTION OF SOME PREFERENTIAL FORMS OF EMBODIMENT

With reference to fig. 1, an automatic multi-function multi-needle sewing machine 10 is shown, in this case a

multi-needle quilting machine with electronic command, of a substantially conventional type.

The sewing machine 10 according to the invention substantially comprises an inlet assembly 10a, a sewing assembly 10b and an outlet assembly 10c.

The inlet assembly 10a feeds the textile material 11 on which the stitches are to be made, and is managed and controlled by a control unit 17, so as to move the textile material 11 in any direction whatsoever, backwards-forwards or left-right, in order to make any design, even the most complex.

The sewing assembly 10b comprises upper sewing members 12 and lower sewing members 15 of a conventional type.

The upper sewing members 12 consist, in this case, (figs. 2-5) of two needle-bearing bars 13, respectively front 13a and rear 13b, parallel to each other, on which respective needles 14 are mounted, aligned with each other, each one cooperating with a respective thread 16, called the needle thread, fed from respective reels 116 disposed on a creel adjacent to the machine 10.

The needle-bearing bars 13a and 13b have seatings 38 to position the needles 14, which are clamped therein by means of screws 39.

For a better understanding of the invention, figs. 2, 3,4 and 5 show only some needles 14, it being obvious that according to the type of stitch to be done all the seatings 38 can house a relative needle 14.

The needle-bearing bars 13a and 13b are equipped with alternating ascending-descending movement, to take the needles 14 to cooperate with the respective lower sewing members 15, consisting in conventional fashion of shuttles, rotary crochets or alternately mobile hooks.

The cooperation between the sewing members 12 and 15

(fig. 1) determines the simultaneous formation on the textile material 11 of a plurality of stitches 18 which, according to the movement imparted to the textile material 11, make desired patterns to obtain the quilted manufactured article which is collected by the outlet assembly 10c.

During the sewing cycle the needle-bearing bars 13a and 13b cooperate with an auxiliary supporting bar 19, disposed transversely, parallel to them and movable alternately in an ascending-descending direction, in a manner correlated to the movement of the needle-bearing bars 13a and 13b.

The auxiliary supporting bar 19 consists of a high-resistance aluminum plate on the upper surface of which are made, on both sides, a plurality of equidistant housings 20, whose interaxis substantially corresponds with the distance between the needles 14.

On the lower surface of the auxiliary supporting bar 19, a plate 21 made of antifriction material is attached, having on both flanks a longitudinal groove with a rectangular section 22, inside which a toothed belt 23 slides, with a development such as to cover the whole lateral perimeter of the auxiliary supporting bar 19.

The toothed belt 23 is made of flexible plastic material with toothings on both sides, it slides inside the corresponding grooves 22 of the antifriction plate 21, with one toothed side in contact with the bottom of said grooves 22 and the other toothed side protruding towards the outside.

At one end of the auxiliary supporting bar 19 a toothed return pulley 24 and a toothed guide pulley 25 are assembled, both idle.

The toothed belt 23 rotates around the return pulley 24 (fig. 3) which, being adjustable, also functions as a

tensioner and is oriented by the guide pulley 25 which takes it to adhere precisely to the bottom of the relative groove 22.

At the other end of the auxiliary supporting bar 19 (fig. 5) a command motor 26 is mounted, for example of the electric type, on whose shaft a first command toothed pulley 27 is mounted, on which the toothed belt 23 slides; and a second guide pulley 55, toothed and idle, which allows the toothed belt 23 to adhere precisely to the bottom of the relative groove 22.

According to a variant, the command motor 26 can be electronic, electromechanical, pneumatic, hydraulic, magnetic or other, and the toothed belt 23 can be a cable, a chain, a rack or other.

The command motor 26 is managed by the control unit 17 of the sewing machine 10 and is able to impart to the toothed belt 23 movements with a cadence, amplitude and direction that vary according to the signals received from the control unit 17, according to the operation to be performed, for example set by the operator at the start-up of the machine 10.

When multiple stitches are to be done, with an unlimited number of ornamental designs or patterns on simple, multi-layer or padded fabrics 11, a plurality of standard static feet, simple 28 or triple 28a, are mounted on the supporting bar 19, in positions corresponding to the needles 14.

Each standard foot 28 and 28a has a plane part 60 able to fit precisely in a corresponding housing 20 and be fixed therein with suitable screws 29, and a shaped part 61, spoon-shaped, equipped with suitable holes through which the needles 14 pass, mounted on the respective needle-bearing bars 13a and 13b.

When the standard feet 28 or 28a are fixed to the auxiliary supporting bar 19, their spoon-shaped parts 61 protrude laterally and downwards on both sides of the supporting bar 19, so that the latter assumes the function of a fabric-pressing plate in which the shaped parts 61 of the standard feet 28 and 28a press the materials 11 on which the stitches 18 are to be made, in the areas where the needles 14 pass, so as to obtain well-knotted stitches especially in the case of padded materials.

During this type of working, the auxiliary supporting bar 19 behaves like a simple fabric-pressing plate and the toothed belt 23 and the command motor 26 remain inactive.

When strips 33, ribbons or trimmings 34 are to be applied, on simple, multi-layer or padded fabrics 11, fed continuously from rolls, instead of the feet 28, 28a, a plurality of ECORDING type robotized feet 30 (fig. 6) are mounted on the auxiliary supporting bar 19, in positions corresponding to the needles 14 being used; the feet 30 are also provided with a plane part 60, substantially equivalent to that of the aforesaid standard feet 28, 28a, which is inserted and fixed in the housings 20 of the auxiliary supporting bar 19.

The ECORDING type robotized feet 30 are provided with a toothed pulley 31 whose teeth, during use, cooperate with the toothed belt 23, so that any movement whatsoever of the latter is transmitted to the toothed pulleys 31.

The toothed pulleys 31 have axially a through hole 54, inside which suitable cylindrical inserts 32 made of ceramic material are inserted under pressure. Each cylindrical insert 32 has an axial hole 29 for the passage of the needle 14 and, in this case, a hole 56 and two hollows 57 and 58 having different diameters and widths. The hole 56 and the hollows 57 and 58 are disposed

eccentric with respect to the axial hole 29, and are offset angularly by about 120° one from the other. Through the hole 56 and the hollows 57 and 58 the strips 33 or the tapes 34 are made to pass, normally fed by bobbins 35 (fig. 1) disposed in the upper part of the sewing machine 10.

There may be a different number of holes, for example two or more, and the angle of rotation of the pulleys is consequently modified.

For application on simple, multi-layer or padded fabrics, fed continuously from rolls, the strips 33 are advantageously made to pass in the holes 56 with the diameter most similar to theirs. This operation is performed automatically by the control unit 17, which commands the motor 26 so that, according to the diameter of the strip 33, the motor makes the toothed pulleys 31 rotate in order to automatically position the corresponding holes 56 in the correct working position with respect to the needles 14.

During normal sewing, performed with alternate ascending-descending movements of the needle-bearing bars 13a and 13b and the mating auxiliary supporting bar 19, the command motor 26 imparts to the toothed belt 23 alternate movements simultaneous with the stitches made by the sewing machine 10. This alternate movement is consequently followed by all the toothed pulleys 31 of the ECORDING type robotized feet 30 which, with every stitch, perform a rotation alternately towards the right and towards the left.

The alternate rotations, of programmable variable amplitude, determine the spiral winding of the strips 33, around the relative needles 14 and their threads 16, for an angle determined by the angle of rotation of the command motor 26.

In this way, each strip 33 is fixed to the continuously

fed fabric 11 without the needle passing through the strip 33 itself.

In this condition the strips 33 are drawn downwards by the descending movements of the needles 14 and sewn onto the textile material 11 by the threads of the needles 16, according to the ornamental design or profile programmed, from the simplest with a linear development, to the most complex and substantially comparable to embroidery.

If tapes 34 are to be fixed on simple, multi-layer or padded fabrics 11 fed continuously from rolls, the same ECORDING type robotized feet 30 are used, mounted in the positions corresponding to the needles 14 intended to be used, and the tapes 34 are threaded into the hollows 57 with the width most similar to theirs. This operation too is performed automatically by the control unit 17 which, according to the type of tape 34 to be applied, commands the motor 26 so that it makes the toothed pulleys 31 rotate in order to automatically position the corresponding hollows 57 in the correct working position with respect to the needles 14.

During normal sewing, performed with alternate ascending-descending movements of the needle-bearing bars 13a and 13b and the auxiliary supporting bar 19, the command motor 26 imparts to the toothed belt 23 small corrective movements which the toothed pulleys 31 of the feet translate into small rotations. In this way, the ECORDING type robotized feet 30 constantly maintain the tapes 34 in front of the needles 14, according to the direction of stitching. Therefore, the tapes 34 are fixed on the simple, multi-layer or padded fabrics 11 with stitches that are always at the center of the tapes 34, according to the ornamental design or profile programmed.

If crimped tapes 36 are to be applied (fig. 7) on simple,

multi-layer or padded fabrics 11 fed continuously from rolls, a plurality of RIRI type robotized feet 37 are mounted on the auxiliary supporting bar 19, in positions corresponding to the needles 14 in use. The RIRI type robotized feet 37 are also provided with a plane part 60 identical to that of the standard feet 28 and 28a and of the ECORDING type robotized feet 30. To be more exact, the plane part 60 of each RIRI type robotized foot 37 is inserted into the corresponding housing 20 and fixed therein with respective screws.

The function of the RIRI type robotized feet 37 is to make a tape 36 advance intermittently, which is sewn by the needle 14 not flattened, but fixed on the textile materials 11 with adjustable crimping.

To obtain this, each RIRI type robotized foot 37 is equipped with a toothed pulley 40 which has an axial hole 41 through which the sewing needle 14 passes, and a cam 42 driving a pad 43 made of antifriction material, sliding inside suitable guide hollows 44, made in the body of the RIRI type robotized foot 37.

A movable blade 45 made of harmonic steel is fixed on the pad 43 with a slight inclination; the lower free end thereof is advantageously shaped like a saddle so as not to interfere with the needle 14. The movable blade 45 slides with a slight pressure on a fixed blade 46 beneath, also made of harmonic steel, rigidly fixed to the RIRI type robotized foot 37. The tape 36, fed by the relative bobbin, disposed in the upper part of the sewing machine 10, slides between the movable blade 45 and the fixed blade 46 and is guided by two adjustable cursors 49 fixed at inlet to the RIRI type robotized foot 37.

During normal sewing, performed with alternate ascending-descending movements of the needle-bearing bars 13a and 13b

and the mating supporting bar 19, the command motor 26 imparts to the toothed belt 23 alternate movements of adjustable amplitude that are repeated by the toothed pulleys 40 and transformed by the cam 42 into alternate backwards-forwards movements of the pad 43 and consequently of the movable blade 45 with respect to the fixed blade 46. In any case, the stitch can be either rectilinear, or curved by 360°.

Due to the effect of the alternate movements, the movable blade 45 thrusts the tape 36 forwards, making it slide on the fixed blade 46 above the tape 36 already sewn previously on the textile material 11, and takes it under the needle 14 so that it is sewn above the previously sewn tape 36, thus creating the crimping. The forward movement of the tape 36 is proportional to the movement imparted by the toothed belt 23.

When the toothed belt 23 inverts its movement, the cam 42 makes the pad 43 and consequently the movable blade 45 retreat, so that the tape 36 also returns backwards and is sewn simply by the needle 14 onto the textile material 11 and so on.

In this way, by programming the control unit 17 with different values, it is possible to vary the rotation of the command motor 26 and consequently to make the movable blade 45 perform more or less ample travels. By doing this, it is possible to obtain different crimpings of the tape 36.

By suitably programming the movement of the textile material 11, different ornamental designs can be performed, from the simplest with a linear development to the most complex, similar to embroidery.

If the crimping is to be performed over the whole width of the fabrics 11, simple or with a lining beneath, fed

continuously from rolls, a plurality of PLISSE' type robotized feet 47 (fig. 8) are mounted on the auxiliary supporting bar 19, in positions corresponding to the needles 14.

The PLISSE' type robotized feet 47 are inserted with their respective plane parts 60, identical to the previous ones, into the mating housings 20 on the supporting bar 19, and fixed therein.

The PLISSE' type robotized feet 47 are similar to the RIRI type robotized feet 37, except that they are not provided with the fixed lower blade 46, so that the movable upper blade, indicated by the reference number 45a, acts directly on the fabric 11 to be crimped, making it slide alternately forwards, or above the sliding surface for the fabrics of the sewing machine 10, in the case of a simple fabric, or above the lining below, if it is present.

In this way, the needles 14 fix between them, or on the lining below, the folds created by the movements of the respective movable blades 45a.

The amplitude of feed of the fabric 11 to be crimped can be modified by suitably programming the control unit 17, so as to make the movable blade 45a perform more or less ample travels by means of the toothed belt 23, thus obtaining different types of crimping of the textile material 11.

On the contrary, if paillettes 80, strass, or other similar ornamental elements, are to be applied by means of stitches on simple, multi-layer or padded fabrics 11, fed continuously from rolls, a plurality of robotized feet 70, called PAILLETTES type feet, are mounted on the auxiliary supporting bar 19 by means of said standardized attachment means, in the positions corresponding to the needles 14 intended to be used. Apart from the standardized plane part 60 that connects with the auxiliary supporting bar, the

feet 70 have a part 71 protruding laterally from the auxiliary supporting bar 19 itself.

The PAILLETTES type robotized feet 70 are each equipped with an assembly to feed and cut the paillettes 80, fed in the form of a strip 81, and are commanded by a toothed pulley 72, rotating idle on bearings 84 and having a central hole 73 through which the relative sewing needle 14 passes.

Each of said toothed pulleys 72 is equipped in the lower part with an eccentric element 74 which drives a sliding pad 74 made of antifriction material, on which a cursor 76 is fixed carrying at its end a steel foil 77 shaped like a flexion spring. The free end 77a, pointed, of said foil 77 slides on the bottom of a longitudinal groove 78 made in the laterally protruding part of the PAILLETTES foot 70, the size of said groove 78 being such that the strip 81 that feeds the paillettes 80 slides precisely therein, passing below the toothed pulley 72. In this case, as in the cases previously described, the command motor 26 imparts to the toothed belt 23 rotational movements which are repeated by the pulley 72 of the PAILLETTES type robotized foot 70 and transformed by the command cam 74 into alternate backwards-forwards movements of the movable foil 77 with respect to the bottom of the groove 78. During the backward movement, the tip 77a of the movable foil 77 is elastically inserted into the hole 82 of one of the paillettes 80 of the strip 81 and, during the forward movement, thrusts forwards the strip 81 that feeds the paillettes 80, making it slide on the bottom of the groove 78 and making it advance by a quantity more or less equal to the diameter of the paillettes 80 in use. Consequently, the first paillette 80a of the strip 81 that has to be applied finds itself with its hole 82 in axis with the hole

73 in the toothed pulley 72 through which the needle passes. To gauge the exact position of the paillette 80, a centering device is provided, consisting of a supporting pin 79 fixed to the protruding part of the PAILLETTES foot 70. A ring 85 rotates on the pin 79, bearing a positioning hook 86 with the same diameter as the hole 82 of the paillettes 80 in use, a drive lever 90 and a return-action spiral spring 87. As already said, during the backward travel of the sliding pad 75, the tip 77a of the feed foil 77, thanks to its shape, jumps elastically from the hole 82 of the previous paillette 80 to that of the following paillette on the strip 81, without making it slide backwards because it is braked by a felt 88 which presses it against the bottom of the groove 78, while a peg 89 mounted on the cursor 76 thrusts the drive lever 90 backwards, causing the positioning hook 86 to lift, the end of which, hook-shaped, exits from the hole of the paillette 82 in which it was inserted and also causes the spiral spring 87 to load.

During the forward travel of the sliding pad 75, the tip 77a of the feed foil 77, thanks to its shape, enters into the hole 82 of a paillette 80 and thrusts the strip 81 forwards, making it slide on the bottom of the groove 78, while the peg 89 gradually releases the drive lever 90 and consequently, due to the effect of the thrust of the spiral spring 87, the pointed hook of the positioning hook 86, is lowered and inserted into the hole 82 of the previous paillette 80 on the strip 81, exactly centering the first paillette 80 with the axis of the relative sewing needle 14. A plane contrasting foil 91, suitably shaped, keeps the strip 81 pressed inside the groove 78 in the last segment between the positioning hook 86 and the toothed pulley 72.

Depending on the operating cycle, the feed movement of

the strip 81 occurs during the descending movement of the sewing needle 14, so that the needle 14 enters into the hole 82 of the paillette 80 to be applied (the first on the strip 81) at the moment when the paillette 80 is centered with the axis of the needle 14 by the positioning hook 86. At this point, it is necessary to cut the paillette 80 from the strip 81 to allow it to be fixed on the fabric by the sewing needle 14.

To this purpose a rotary blade 92 is provided, consisting of a hardened steel ring 93 inserted into the lower part of the hole 73 in the toothed pulley 72 where the needle passes. The ring 93 has a protuberance in the part facing downwards which protrudes from the lower plane of the toothed pulley 72; the protuberance in turn has a small sharpened platelet 94 rotating in a circular groove which, during its rotation, comes into contact with the side of the strip 81 and is inserted into the throat between one paillette 80 and the next, cutting the first paillette 80 at the moment after that when the needle 14 has entered the hole 82 of the paillette 80. The bobbin that feeds the strip 81 is positioned above the paillettes foot 70 and is supported by an arm equipped with a pin on which the bobbin rotates, attached to the structure of the machine.

According to the invention, the feed foil 77 and the support of the rotation pin 79 of the positioning hook 86 are adjustable so as to allow the exact phasing thereof and to obtain the exact distance between the hole 82 of the paillette 80 in which the positioning hook 86 is inserted, and the first paillette 80 of the strip 81 that is to be applied.

As already said above, the paillettes 80 can be applied on the fabric 11 in three different ways: sequential, superimposed and with star point, which have already been

described in detail.

Apart from the continuous application of paillettes 80, both sequential, superimposed and with star point, it is also possible to alternate the application of paillettes with segments of normal stitching or embroidery type stitching, and thus create a very large number of ornamental patterns.

The PAILLETTES type robotized foot 70 is suitable to apply paillettes 80 of variable diameter, for example 3 mm, 5 mm, 7 mm, by making the necessary modifications and adjustments of the components.

On the contrary, when tapes, ribbons or trimmings 48 are to be applied, disposed transverse to the direction of advance of the fabrics 11 on simple, multi-layer or padded fabrics, all the standard feet 28, 28a or robotized 30, 37, 47, which are possibly present on the front part of the auxiliary supporting bar 19, are dis-assembled, and on the front part of the auxiliary supporting bar 19, a suitable sliding guide 50 is applied (figs. 9, 10, 11) on which a particular slider slides, called TRESSE' 51.

The TRESSE' type slider 51 is similar to the ECORDING type robotized foot 30, since it is equipped with a toothed pulley 31a substantially equal to that of the ECORDING type robotized feet 30, provided with the same insert made of ceramic material, in this case indicated in its entirety by the reference number 32a, provided with a central hole 61 for the needle 14a.

The TRESSE' type slider 51 is provided with a clamping device 52 able to selectively clamp the rotation of the toothed pulley 31a so that, when the latter is clamped, the movement of the toothed belt 23 determines the movement of the TRESSE' type slider 51 along the corresponding guide 50, transverse to the fabric 11.

Moreover, in this embodiment, a needle 14a is mounted at every one of the ends of the needle-bearing bar 13a, without the corresponding standard feet 28, 28a on the auxiliary supporting bar 19, while on the needle-bearing bar 13b a plurality of needles 14 are mounted, corresponding to the number of stitches to be performed, with the standard feet 28 mounted on the rear part of the auxiliary supporting bar 19, in correspondence with the needles 14.

In this case, the tape or ribbon or trimming 48 is fed from a bobbin, of a substantially conventional type and not shown in the drawings, and is made to pass in a corresponding hollow 62 made through on the insert 32a of the toothed pulley 31a.

The TRESSE' type slider 51 substantially provides the following functioning cycle.

In a first step, the TRESSE' type slider 51 is stationary, for example at the right end of the auxiliary supporting bar 19. In this case, the toothed pulley 31a is clamped by the clamping device 52 (fig. 10) in a position such that its central hole 61 is in axis with the needle 14a mounted at the right end of the needle-bearing bar 13a, and its hollow 62 through which the tape 48 passes is behind said needle 14a with respect to the side on which the fabrics 11 are inserted.

In a second step, the sewing machine 10 starts to sew, the fabrics 11 are fed forwards, all the needles 14 perform parallel stitches and the stitch of the needle 14a mounted at the right end of the needle-bearing bar 13a fixes the tape 48 to the fabric 11. In this step, the TRESSE' type slider 51 acts as a fabric pressing element.

In a third step of the cycle, the needles 14 stop in a high position, the feed of the fabric 11 is stopped and the

clamping device 52 releases the toothed pulley 31a (fig. 11). In this condition, the command motor 26 of the toothed belt 23 performs a small rotation sufficient to make the toothed pulley 31a rotate by 90°, so that the hollow through which the tape 48 passes moves to the left of the needle 14a with respect to the side on which the fabrics are inserted. At the end of this rotation, the clamping device 52 clamps the toothed pulley 31a in the position reached.

In a fourth step, the command motor 26 moves the toothed belt 23, which draws the TRESSE' type slider 51 along the sliding guide 50 until it covers the whole width of the fabric 11. During this travel, the tape 48 passes through the corresponding hollow 62 and is laid transverse on the fabric 11.

In a fifth step, the TRESSE' type slider 51 reaches the left end of the auxiliary supporting bar 19 and the central hole 61 of its toothed pulley 31a is in axis with the needle 14a mounted at the left end of the needle-bearing bar 13a.

In this condition, the command motor 26 of the toothed belt 23 stops and the clamping device 52 releases the toothed pulley 31a. At this point the command motor 26 performs a small rotation sufficient to make the toothed pulley 31a rotate by 90° to take the hollow 62 behind the needle 14a, with respect to the side on which the fabrics are inserted.

Subsequently, a sixth step is performed in which the sewing machine 10 starts sewing. In this step, the fabrics 11 are made to advance and the needles 14 perform parallel stitches so that the needle 14a fixes the tape 48 to the fabric 11, while the stitches of the needles 14 mounted on the needle-bearing bar 13b fix the tape 48 on the fabric 11

as it is laid transversely during the fourth step.

In a subsequent seventh step of the cycle, the needles 14 stop in a high position, the fabric 11 stops and the clamping device 52 releases the toothed pulley 31a. In this condition the command motor 26 of the toothed belt 23 performs a small rotation sufficient to make the toothed pulley 31a rotate through 90°, so that the hollow 62 moves to the right of the needle 14a, with respect to the side on which the fabrics 11 are inserted. When this rotation has been performed, the clamping device 52 clamps the toothed pulley 31a in the position reached.

In an eighth step of the cycle, the command motor 26 makes the toothed belt 23 move in order to draw the TRESSE' type slider 51 along the sliding guide 50 until the central hole 61 of the pulley 31a is in axis with the needle 14a mounted at the left end of the needle-bearing bar 13a. This drawing of the TRESSE' type slider 51 causes the tape 48 to be laid transversely for the whole width of the fabric 11.

At this point the conditions of the first step are restored and a new cycle is started.

At the end of the functioning cycle we obtain the application, by means of parallel stitches, of tapes, ribbons or trimmings 48, disposed transverse to the direction of feed of the fabric 11, on simple, multi-layer or padded fabrics, fed continuously from rolls.

It is clear, however, that modifications and/or additions of parts may be made to the sewing machine 10 as described heretofore, without departing from the field of protection of the present invention.

For example, it comes within the field of the invention to provide that the movement of the toothed belt 23 can be supplied, instead of by the command motor 26, by any suitable drive means, for example of a pneumatic,

hydraulic, mechanical, electromagnetic or other type.

It also comes within the field of the present invention that the toothed belt 23 can be replaced by another transmission element, such as for example a chain, a rack or other.

It is also clear that, although the present invention has been described with reference to specific examples, a person of skill in the art shall certainly be able to achieve many other equivalent forms of automatic multi-function multi-needle sewing machine and relative sewing method, having the characteristics as set forth in the claims and hence all coming within the field of protection defined thereby.